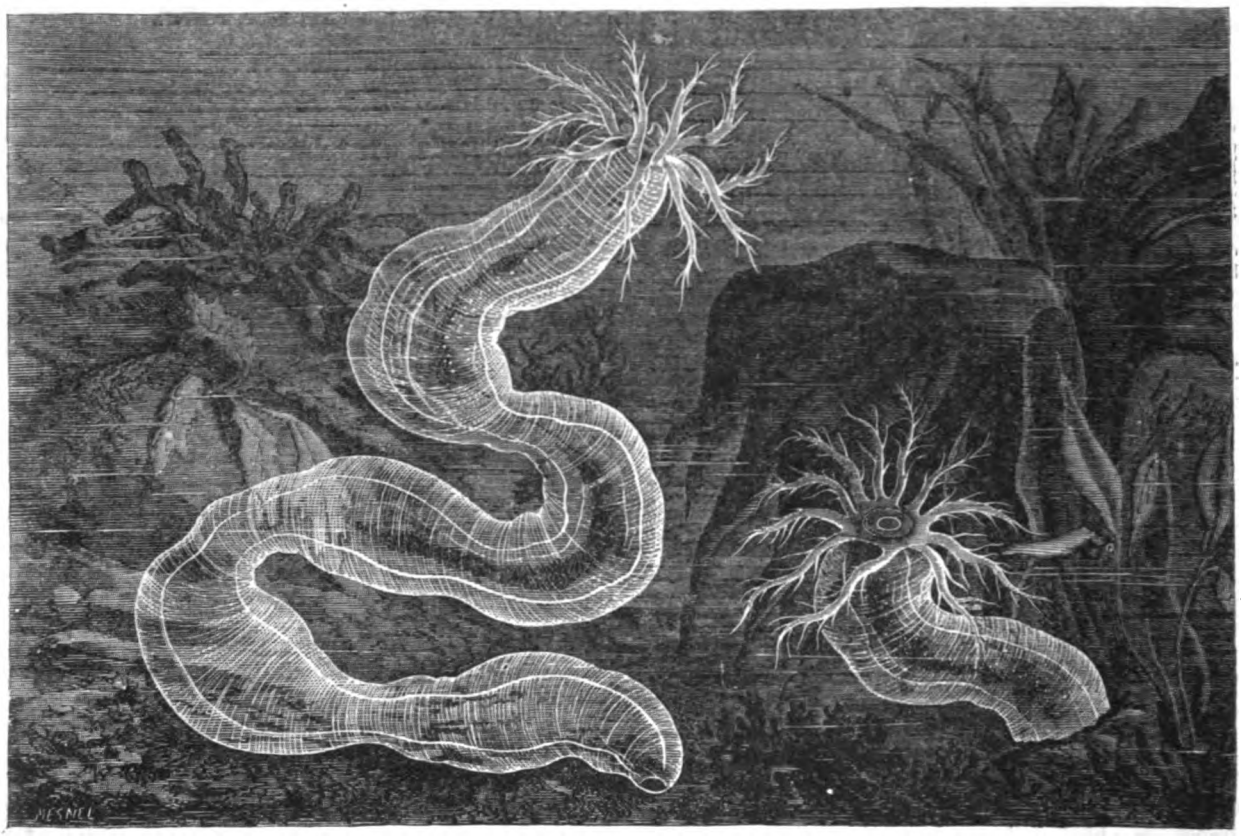
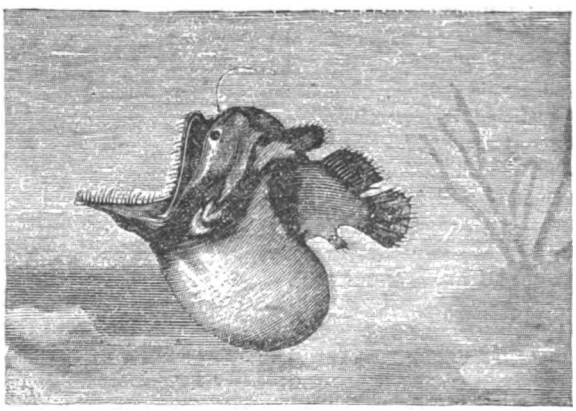


THE SYNAPTA DUVERNAEA, ONE OF THE HOLOTHURIAS.

ANIMAL LIFE ON THE OCEAN-BOTTOM.

By Ralph S. Tarr.

Deep-sea research has for several years been extensively engaged in by the United States Fish Commission, and during the last Summer, by means of its large steamer, the *Albatross*, investigations were carried on in the deepest waters of the North Atlantic. On one occasion a dredging was made in 2,950 fathoms, this being the deepest successful haul of the trawl ever made by any expedition. In the Summer of 1883 operations were carried on in a region south of New England, about 300 miles, in from 1,000 to 3,000 fathoms. There a remarkable form was encountered, different from anything ever found in similar regions. Some forms were identical with species taken by the *Challenger*, and others nearly allied to varieties brought up by other expeditions, but most were different from all previously known animals. The distribution of animals on the ocean bottom is very wide, an animal seldom being confined to a limited area, temperature serving as the main dividing-line; and depth ranks next in degree, as a check upon distribution. We have many forms found in the shallower depths, 500 fathoms or less, which, while they are not encountered in the deepest parts of the ocean, are found upon the coast of Europe in similar depths, and also in the Mediterranean. Furthermore, many of our recently discovered deep-sea animals have proved to be identical with fossil forms found in the Quaternary deposits of Italy. Indeed, we might almost say that all deep-sea animals belong to fossil types, the mere remnants of a former age. In structure, they are as a rule primitive, and highly specialized in certain directions, at the expense of other less developed parts. Such animals as Crinoids, for a long time placed upon the list of extinct animals, have been discovered upon the ocean-bottom, in places in abundance, and often in variety, a number of species and several genera having been described from the North Atlantic alone. Who can tell what remarkable forms of animal life may be found before the whole ocean-bed is thoroughly examined? It is not unreasonable to suppose that Trilobites may yet be discovered in these deep recesses. Deep-sea investigation has yet much to do. It is but just begun —is still in an embryonic condition.



A CURIOUS DEEP-SEA FISH.

Our researches have proved that the bottom of the ocean, in all water deeper than 1,000 fathoms, is composed of globergerinous ooze, so called from the fact that it is mainly

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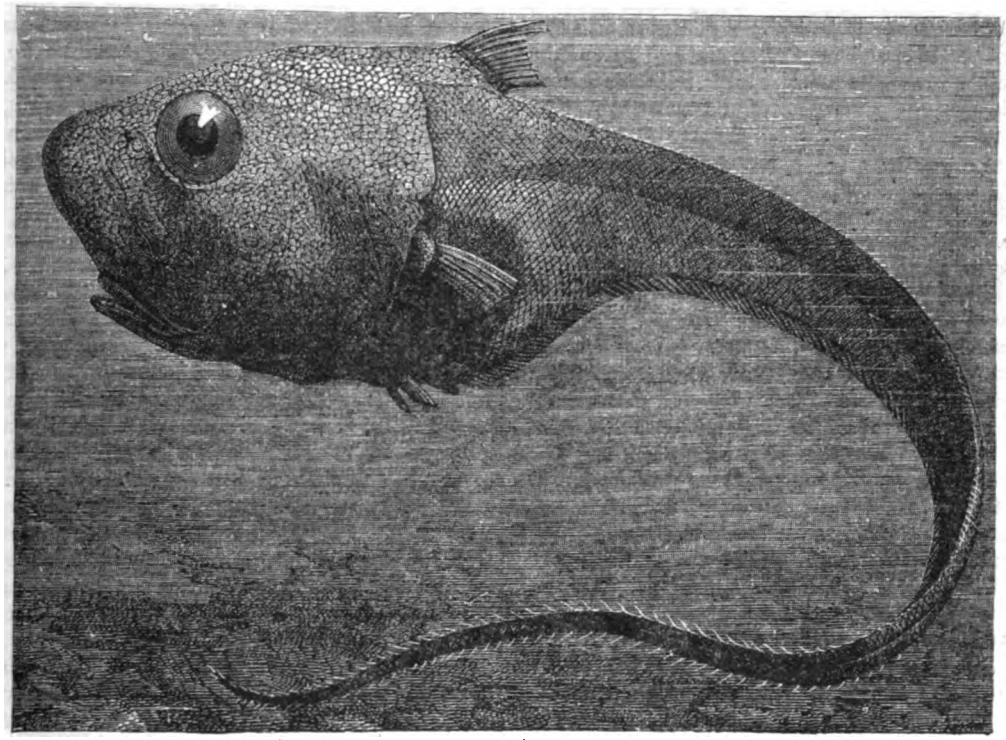
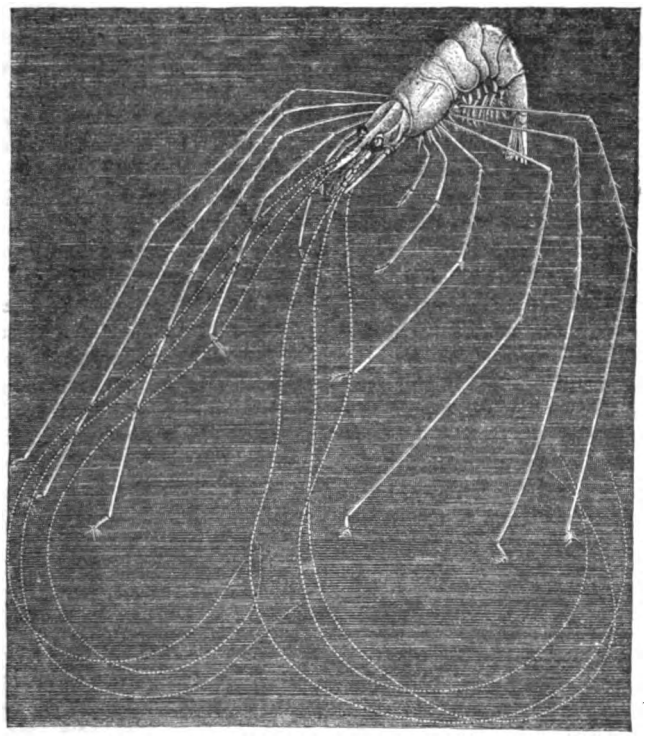


MACRURUS GLOBICEPS.

made up of the living and broken shells of a certain species of Foraminifera, called scientifically Globergerina. It is a thick, blue, sticky mud, containing but little matter besides the calcareous shells which are so abundant. Besides this, there is some meteoric iron. The absolute absence of sand and rocks is well marked. Ice, or floating sand from shore, as soon as it strikes the Gulf Stream, is immediately carried away and deposited. This serves as an effectual barrier to all such foreign matter. From the shore to a distance of 100 miles south of Southern New England the slope is very gradual, forming a great submarine plateau, of 100 fathoms depth at its outer end. From this 100-fathom line to 1,200 fathoms the slope is exceedingly rapid, being usually as steep as the slope of large mountains, and as high as Mount Washington, New Hampshire. We call this the Gulf Stream Slope, because it underlies the inner edge of the Gulf Stream from Cape Hatteras to Nova Scotia. A change of position of ten miles will at some points make a difference of 600 fathoms in depth. From this immense slope the great ocean-basin is encountered, and here the slope is much more gradual, to the very deepest parts. Foraminifera, the basis of the muddy ocean-bottom, are the lowest group of the animal kingdom, belonging to the group of the Protozoa. Their near allies are Amœba, found so abundantly upon the damp leaves and pieces of bark and in stagnant pools—in fact in nearly every place where fresh water exists. This group of Foraminifera is the one which in past ages gathered in such masses as to form the immense chalk cliffs of England. They probably lived in much shallower water than their allies do at present, and were washed into banks which subsequently hardened into chalk. Material for a similar formation is now found on the ocean-bottom. By washing the mud, the broken shells and disintegrated parts can easily be disposed of, leaving a perfectly pure deposit of the beautiful shells of this one-celled animal, the lowest form of life so far known to man.



LUMINOUS SHRIMP, FOUND AT A DEPTH OF 850 METRES.

The animal inhabitant itself is very simple, being one-celled, without any special organ. Whenever it desires to take food, a particle is surrounded by a portion of the soft body and is allowed to enter, through what might be

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called the skin, into the interior. Any portion of the external cell-covering can serve as a temporary mouth, closing over the particle, and leaving no trace of an opening. The undigested remnants are ejected in a similar manner. If motion is desired, a pseudopod or foot is thrown out, this being any part of the animal, and into this pseudopod the liquid cell-contents begin to pour. The whole animal actually flows into its foot, which then ceases to be a foot, and the shell is drawn after it. The cell-walls are very elastic. The shells of this group are remarkable for their beauty of shape and color.

These microscopic shells are usually composed of carbonate of lime, but there are siliceous species, and, in the shallower waters, sandy forms. Some are as smooth and glossy as the best glazed chinaware, showing beautiful concentric rings of different hues, while others are rough, and lobed in a manner which defies description. Still others are the most beautiful shade of pink, and some present in color a most delicate chocolate-brown. We find them tubular, coiled, cross-shaped, spherical, oval, and in masses which look as if it started with a spherical form, and the animal, needing more room, pushed out a portion of the side into a hemispherical protuberance, and continued to do this whenever more room was needed, until a mass of lobes upon lobes was the result.

Perhaps the most curious form is one which has the general shape of a nautilus, and upon making a section, it, too, is found to be composed of sections. This form was formerly classed as a nautilus. Although these animals are one-celled and microscopic, that symmetry exists which is always found in the living and natural, but seldom in the accidental. That inevitable and unchangeable law of symmetry exists even in these one-celled beings, the lowest forms of animal life. In no case do we find one of them having the irregular outline which is to be seen in grains of sand chipped off from larger rocks, and worn into accidental shapes. Some pre-established law causes these regular forms; in fact, causes them to produce like regular forms differing in no respect from their parents.

It is thought by many that these shells live on the surface, and drop to the bottom after death. Certain it is that some do, but I am of the opinion that most of them live and die upon the ocean-bottom. This must be true of the large sandy forms, and as we take so few upon the surface in our tow-nets, it seems probable that many other forms must also live on the bottom. Earbones of fishes are very abundant, mixed up in the foraminiferous mud, and these, with the exception of an occasional shark's-tooth, are the only remnants of dead fishes ever taken. This seems very strange, for there must be a constant rain of such deposits. Their absence is accounted for only by supposing that they are devoured by the small scavengers as soon as they drop down.

We once set a trawl* baited for deep-sea fish, and upon drawing it up found one fish firmly hooked, and almost entirely devoured by a small species of Amphipod. They must have attacked him after he had been hooked, and in a few hours nearly devoured him, although it was a fish nearly two feet long. Iron and wood are never taken, but we frequently find cinders, when in the tracks of ocean steamers, and once we hauled up a wine-bottle, and again a rubber doll, both imperishable articles. That the bottle had been there for some time was proved by the fact that it had numerous hydroid animals on it.

Upon the ocean-bottom there can be no light, and, indeed, actual photographic experiments have proved that practically there is absolutely no sunlight in water deeper than 1,000 fathoms. For this reason we find no plant life. Sunlight is absolutely essential for plant growth, which is not at all the case with animals. Notwithstanding the absence of sunlight, most bottom animals have eyes, well developed, though there are some in which no traces of visual organs are found. If the creatures have eyes, they must have some use for them, otherwise they would be lost, for Nature supports no useless organs. It is for this reason that we suppose phosphorescence to be the common form of light. We conclude that it must not only be abundant, but of a very brilliant character. Certain corals retain their phosphorescence even after being brought to the surface.

The temperature on the bottom varies from thirty-four degrees, Fahrenheit, to thirty-eight degrees, with an average of thirty-six degrees or thirty-seven degrees. The pressure is very great, many tons to the square inch, but on account of the penetrable character of the animal tissue of bottom forms, this pressure is easily borne, in the same manner that the fifteen pounds per square inch is counteracted in man's own case. Water brought from bottom in hermetically-sealed bottles foams like soda-water, and is thrown many feet in the air when opened at the surface. Fish come up with their eyes protruding and the air-bladders forced out of their mouths; and often they are burst open.

At all depths, even as deep as has been explored, we find life to be very abundant, and of great variety, every group of the animal kingdom being represented there, except the higher vertebrates and insects proper. One of the most abundant groups encountered is that called Gorgonia, or soft coral. The hard, stony corals are represented only by the one polyped form. This is simply a sea-anemone surrounded by a stony coat, pointed at the end, and held in place by being stuck into the mud. Soft corals are extremely abundant, and represented by many varieties. *Primnoa reseda*, the bush-coral, and *Paragorgia arborea*, the tree-coral, both first found on this side of the Atlantic, and presented to the Fish Commission by the Gloucester fishermen, and last Summer obtained by the Commission itself, are remarkable for their great size and beauty, the former being a delicate pink; the latter, a pink bordering upon red. Specimens of the tree-coral four feet in length bear evidence of being mere branches, while we have taken bases which, had they been produced as they were naturally, would have undoubtedly been ten or fifteen feet high, and nearly that number of feet in width. The animals forming this colony produce in unison a rather tough, spongy mass, branching and growing in bulbs. The polyps can contract and withdraw into this mass, but are fixed permanently into one place. They reproduce by dividing, one on the end splitting into two perfect polyps, and each secreting the spongy mass, they become separated, and it is the constant repetition of this that causes the cluster grove.

The shape of coral masses depend upon the manner in which the polyps divide. There are always tubes connecting the polyps together. Occasionally a polyp buds off from its mother, and dropping into the water, swims about for a time, and then locates itself upon some rock and begins a new colony. In the case of the bush-coral, a hard, siliceous central axis is secreted in each branch, and the animals live in little bell-shaped cups attached

* Fishermen use the term *trawl* to signify an apparatus composed of a long line, from which hang many hooks. This whole thing is weighted and lowered to the bottom, and afterward drawn up, and the fish taken from the hooks. In this sense it is used here. The trawl proper is a very large dredge.

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to the stem by the base. When these umbels are rubbed off a bare stem is left, which might be easily mistaken for the petrified branch of a tree.

Upon George's Banks, in about 300 fathoms, these immense corals form large groves, in which fishes dart about, spectre-like, in the phosphorescent light, preying upon smaller animals, which vainly endeavor to escape. These groves have been the scene of many a disaster, and when the waters above are roughened by violent storms, an incessant torrent of fishing-vessels, with human freight, have received their burial among the broken branches. Upon the stems of these corals large barnacles, often two inches in diameter, resembling common rock-barnacles, except in size, frequently make their home.

Upon the great ocean-bed, where no rocks or solid foundations of any kind are found, such animals as need a firm base to rest upon are seldom taken. Sponges, hydroids, barnacles, etc., are very rare after the 500 fathom-line is reached, and when found they are very small, attached to broken stems of gorgonians, much too small for their support.

The curious devices adopted by clusters of animals for supporting their mass in an upright position are remarkable, and there are cases where evolution must certainly have taken place, and furnished the group with a much-needed organ. This is seen in the case of a peculiar gorgonian, which, for its own support, to hold itself in an upright position, has a circular membrane projected into the mud, a portion of which it envelops, and then, by constricting the open end, it has a heavy ball of mud, surrounded and protected by a membrane. By this means the cluster is held in position by a weighted base. A very few miles from where this is found, in shallow water, and where rocks are abundant, there is a species almost identical with this one, in all points except that it attaches itself to rocks. Now, it seems perfectly probable that a free-swimming polyp from the shallower species by some cause found its way into deep water, and when the time for fixing itself arrived, no firm basis was encountered; so it settled down upon the mud, and when it grew and branched, being top-heavy, it toppled over. Other polyps from the same colony had a similar experience, until a means of firm fixation evolved itself, from necessity.

The Pennatulacea, or sea-pens, beautiful clusters of bright-red and purple polyps upon a straight stem, the base of which is slightly bulb-shape, tapering gradually to the end, receive the name from the fact that the polyps are all on one side; and on account of this, together with the pointed end, the resemblance to a quill-pen is very marked. The most peculiar and interesting of this group of Radiates is that rather aberrant form of Pennatulids, the Umbellifera, so named from their resemblance to an umbelliferous flower. In this case there is a stem, often two feet in length, fastened in the mud by means of an elongated bulb, but bearing upon the other end a peculiar cluster of animals, which, as they gracefully bend over, have an almost perfect resemblance to certain umbelliferous flowers. Pennatulids fasten themselves in the mud by means of bulbs, but there is a group of gorgonians found in those regions which have perfect branching roots ramifying through the mud. If there was a very strong current on bottom, the mud would be washed away from the roots, and the cluster would fall.

The allied animals, the sea-anemones, are not often found in the greater depth, but are taken in great varieties in from 100 to 500 fathoms, where there are rocks. One, a large kind, beautifully colored and spotted, will, after being taken from seventy-five fathoms, live and thrive when placed in an aquarium. We have thus kept them during the entire Summer, and as they alternately expand and contract, they are most interesting creatures to watch. When fully expanded they are six inches high, and as broad across the base. By means of their stinging, or lasso cells, they can kill very large fishes. These arrow-pointed affairs are attached to the end of a coil of ropelike flesh, all stowed away in a little cell. When anything approaches, hundreds of these barbs are hurled from the cells, and striking the object, they penetrate, for they have the power of motion, and can work into any animal tissues even after being detached from the animal. Each is covered with a poisonous fluid, and the many in conjunction have a paralyzing effect. I have seen this anemone thus paralyze an active fish a foot in length, and then swallow it, leaving nothing but the fish's tail projecting from the mouth. After digesting a portion the rest is disgorged.

The stinging-cells exist by the millions all over the animal's body, and are replaced as fast as discharged. Although this creature could kill a fish, its cells had no effect upon a man's hand, unless the bare flesh was exposed. Upon one occasion we dredged several bushels of a bright-red anemone, together with a number of rays, or skates. The sharp spines of the rays wounded my hands in several places, and upon handling the anemones sharp pains shot through my arms. I continued, however, until all the anemones were disposed of, the pain all the time increasing, and finally my hands began to swell. Several days elapsed before the pain and swelling ceased. The poison probably would have had no effect had my hands been uninjured.

All brilliantly-colored marine animals are well defended, while those which are poorly defended are inconspicuous, resembling the color of their favorite haunts. The latter are thus for the purpose of escaping the notice of their enemies, while the former, such as sea-anemones, crabs, etc., having no such enemies to fear, by their brilliant colors attract the curious within reach of their deadly powers.

Epizoanthus, a sea-anemone which secretes a sandy substance in its body-walls, after its free swimming stage attaches itself to a shell inhabited by a hermit-crab. In growing and dividing quite a colony is formed, which gradually envelops the shell, leaving only the entrance uncovered; it then absorbs the shell, and is transported from place to place by the hermit. But the crab is furnished with a comfortable, transportable house, which grows at about the same rate that the hermit grows, and is thus an accommodating house. If the shell was not absorbed the hermit would outgrow it, and leaving it, the anemone would be obliged to remain in one place. This is a remarkable case of division of labor amongst the lower animals, entirely different kinds of animals working together for the common good. One furnishes the house for a crab with a very delicate, unprotected abdomen, while the crab returns the favor by transporting the other from place to place and keeping it upright.

Starfishes are the most abundant animals on the ocean-bed, and it has been said that the bottom is literally paved with them. They exist in all varieties, from the five-armed to those with fifteen arms, and from those which are nearly pentagonal in form to the kinds which are formed of a mere disk, having five narrow, brittle arms radiating from it. This latter, the brittle-star, always comes to the surface with its arms more or less broken, for it has the power of snapping them off at will, and from appearances it must use this power very often,

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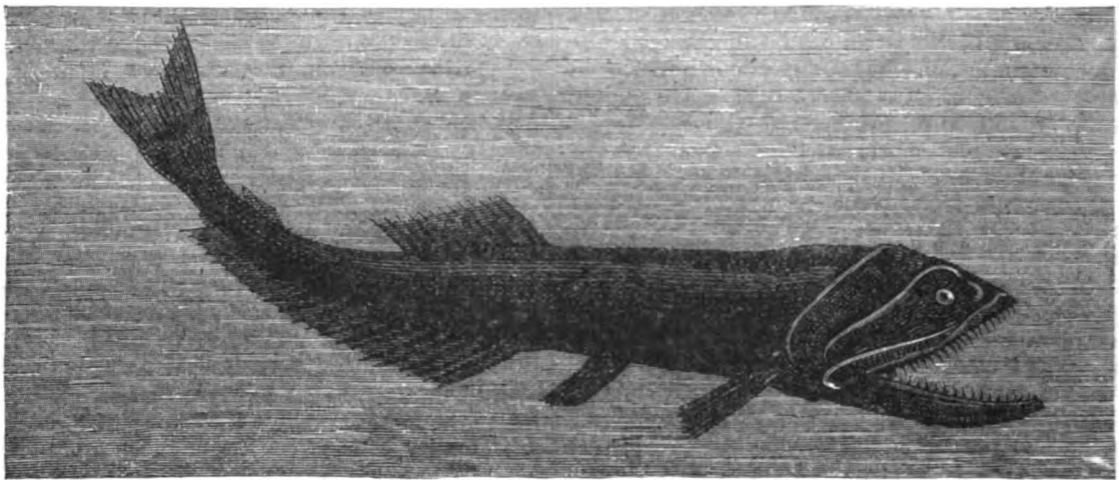
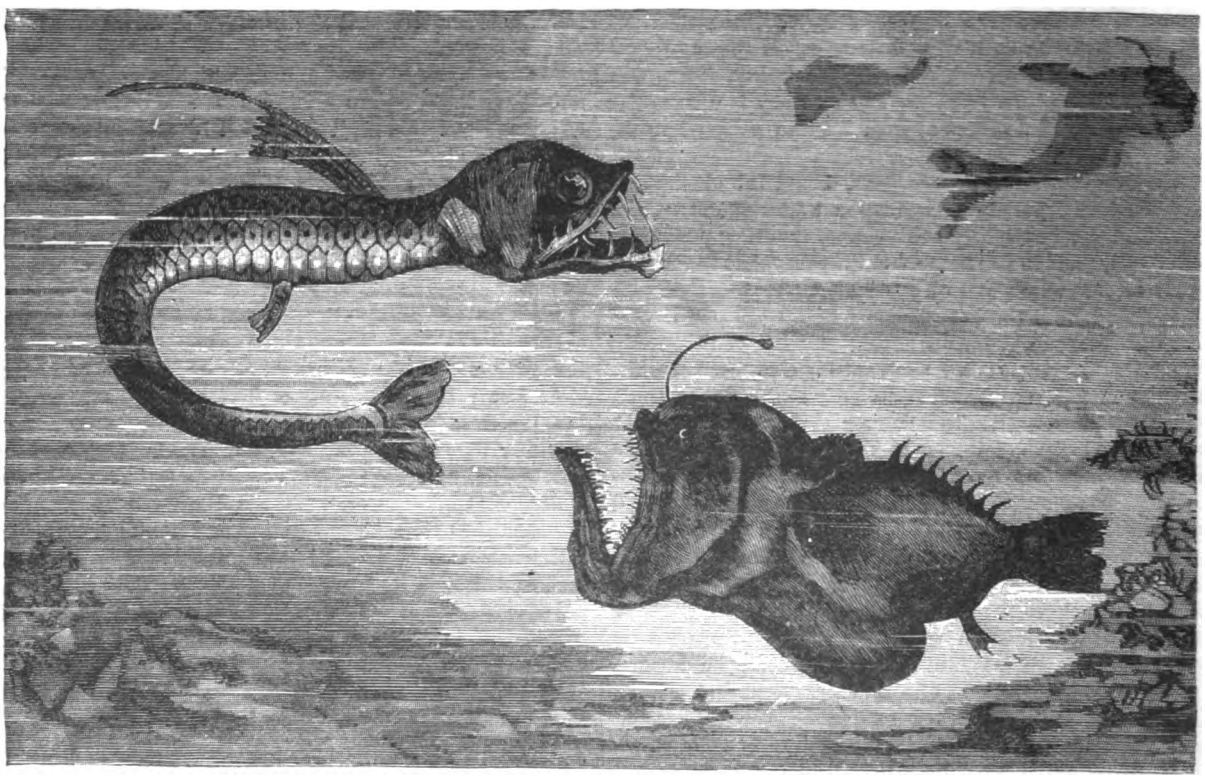


NEOSTOMA BATYPHYLLUM.

though it looks like "cutting off the nose to spite the face." They can reproduce them as fast as they are broken off.

There is a form intermediate between this and the true starfish, called Brisinga, which has the same power, and although it has twelve arms over a foot long, they are frequently taken with all the arms gone and only the disk left. True basket-stars are not found deeper than 100 fathoms, but allied forms, much smaller, are taken in the very deepest waters. Off Cape Cod, in quite shallow water, the bottom is completely covered with the large Astrophyton, or basket-star, and can be taken by the bushel. Antedon, a species of crinoid, more nearly allied to the starfishes than to the true crinoids or stone-lilies, has many feathery branches and no stalk. It always breaks itself into thousands of pieces, and is never obtained perfect. Sea-urchins are found very abundantly at all depths, the flat Clypeasteroids being the most abundant. We also frequently obtain a large, round, white species of Echini, and a form which has very long, sharp spines. A curious flat form commonly taken on bottom has no hard shell, but is soft and flabby.

Our party was surprised one night, when the trawl was hauled up late in the evening, to see large numbers of a great white fork-like mass come tumbling from the bag into the seine. All were puzzled and none could tell what they were, each individual having some group of animals to place them in. Upon dissecting one, however, the mass proved to belong to the Holothurians, or sea-cucumbers, though no external resemblances to this class were to be seen. Upon arriving home, by consulting books, we found that it was similar to species described from the *Challenger* expedition. It has been named *Benthodites gigantea*. The sailors, however, would not



SPECIMENS OF FISH FROM THE BOTTOM OF THE ATLANTIC.

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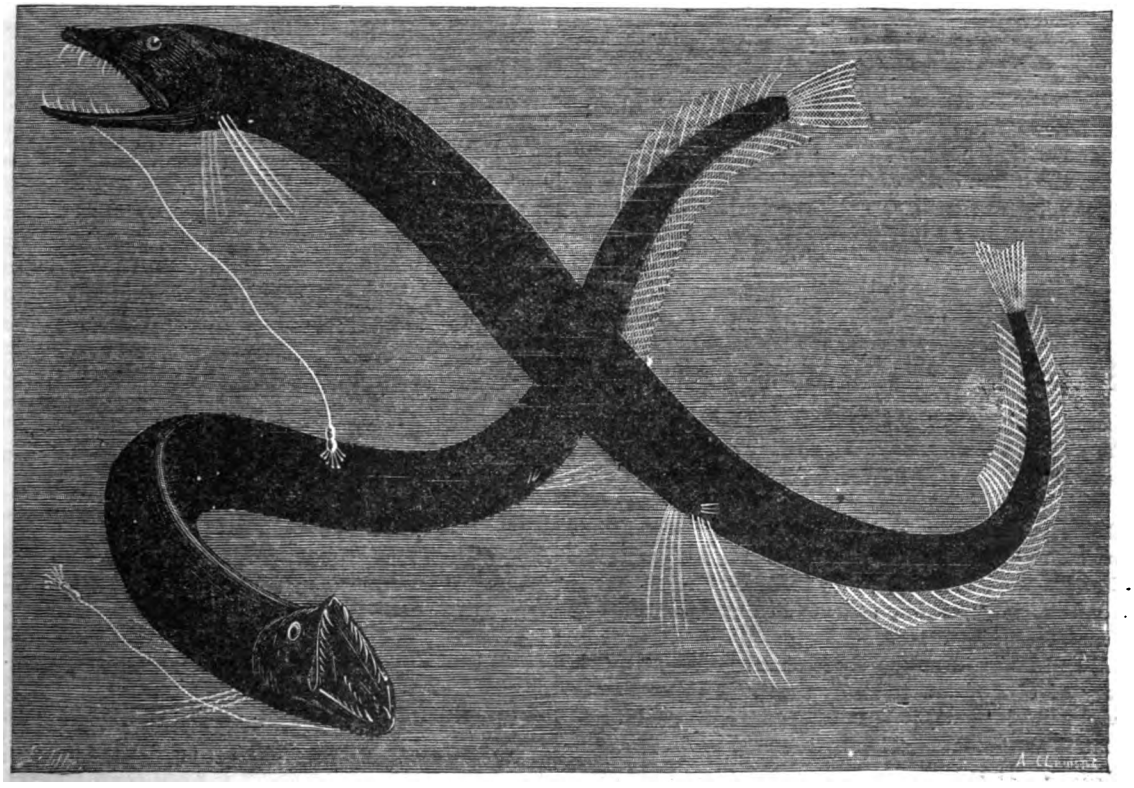
allow it to escape so easily, but christened it by such names as lump-of-pork, loaf-of-bread, and animated-boxing-gloves. The creature was pure white, a foot long, one-half foot wide and two inches thick. Although of this great size, its vital organs were confined to a very narrow line near the central axis of the body, the rest being apparently quite superfluous.

Another species taken during the same voyage was called old-boot by the sailors. There was a marked resemblance to an old, unblacked low shoe. This was named *Europhonides cornuta*, on account of two horn-like projections on the upper surface. Here the resemblance to a Holothurian was more marked; and we afterward took the typical species, and some which were long and worm-like.

Shells were abundant in all places, but as a rule deep-sea shells are small and inconspicuous. It is to be borne in mind that shells proper, or Mollusca, are entirely different from the shelly Foraminifera, the former being quite high in the animal scale of life, the latter the lowest known group. Our most beautiful shell from deep water is named *Calliostoma Bairdii*, in honor of Professor Baird. It is one of the few deep-sea animals which will live in the aquarium. We kept a pair during an entire Summer. In the daytime this shellfish would remain quiet, but at night roamed around the aquarium, frequently crawling over the top and dropping to the floor. This shows that it must be accustomed to comparative darkness. An interesting shell is that called Dentalium, being a long, circular tube, pointed at one end, and having a length of about one-half inch. Many new squid were taken, and most peculiar types were found, all entirely different from any previously known.

Annelids, the group of worms proper, have few remarkable representatives, they being for the most part very small, and represented by similar forms in shallow water further north. The only really curious form is *Hyalinœcia artifex*, which secretes a circular tube open at both ends, and resembling in structure the quill of a bird's feather. In fact it was actually made to serve the purpose of a quill-pen. One of the party went so far as to clean one out, and fitting it to his pipe, used it as a stem. When last seen he was puffing away through a worm-tube taken from the bottom in 500 fathoms.

In places shrimp are extremely abundant, often being taken by the bushel, and in such cases we were always treated to shrimp cooked in various ways. A species of shrimp hauled up from 2,300 fathoms measured a foot in length, and an Amphipod resembling the common sand-flea, nearly three inches long. Crabs, some of them very large, and all bright-colored, were often taken. By far the most interesting animals which have yet been found, are the sea-spiders, or Pycnogonids. It is not yet determined just where in the animal kingdom to place them, for they have affinities both to the Crustaceans and Spiders, and yet are very different from each of these. Many naturalists are of the opinion that they should be placed in an entirely seperate group intermediate between the Spiders and Crustaceans. One specimen, when measured, was found to be two feet, measured from the tips of two opposite legs. Notwithstanding this immense length of legs, the body was but an eighth of an inch in breadth and an inch long. In this small body there is no room for a stomach, so a branch extends from a main tube into the base of each leg. Food is sucked in through a rather long proboscis. When the female lays the eggs, the male stands by and catches them upon a pair of legs peculiar to the male, and they are glued together by a secreted sticky substance. This animal is a mere spectre, made up of eight legs joined together by a tube.



EUSTOMIAS OBSCURUS, FOUND AT A DEPTH OF 2,700 METRES.

Deep-sea fish are very remarkable, and during the past

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Summer many new species were obtained. They were all different from previously-known types. One, *Gastrostomus Bairdii* will probably form the basis of an entirely new order, so peculiar is its type of structure. It has a remarkably long mouth, occupying a great deal more than half the body. The skull is very primitive, and the whole animal is a curious case of extraordinary development. One fish had no traces of eyes ; this, and that of a blind shrimp, being the most remarkable cases of blindness among deep-sea animals.

During the Summer many dredgings were made, most of them being very successful. Each haul contained many species, some of them entirely new to science, proving that life on the ocean-bottom is as abundant and as variable as that on land, and we may say even more so. Picture to yourself a great aerial vessel at a distance of two miles above the earth, trailing along an iron frame with a net behind to catch everything, the frame scraping a piece of ground twenty feet wide through a distance of two miles, and you will have the conditions which exist when dredging. How much animal life would be obtained ? All birds and mammals would escape. So also do the quicker-motioned fishes in the ocean. Yet we frequently bring up bushels at a load, and it seems that certain kinds must be literally piled one upon the other. All of these animals live upon bottom, breathing oxygen and exhaling carbonic acid gas, with no plants to supply new oxygen and absorb the carbonic acid. How is the water purified ? There are many questions to settle in this connection, and there is much ground to be explored. From past experience it is reasonable to suppose that there are many separate faunal belts in the oceans, each having separate kinds of animals, just as on land. If this be true, every part of each ocean must be thoroughly explored before the many curious and interesting animals, so far from the sight of man, can be brought to his view. And even then, judging from the difficulty which students of land animals experience in bringing to light all new forms of life, it will be a long time before one can say that all animals from bottom have been studied ; indeed we might say it is an endless work, which will be still unaccomplished when man's studies cease.

Small and insignificant as these creatures may be, it is the duty of civilization to study them. Apart from the narrow financial point, it is as interesting, as useful and as essential as the exploration of the vast wilds of Africa or Australia. It is the duty which man owes to himself and his fellow-beings to ferret out all hidden truths and wonders ; to make them known to the world. It is as much to be desired that these things be generally known, as past history be known. Man has ceased to be a savage, whose only aim is to supply his body with absolute necessities. It is time that he should cease to be that which is little better—a grasper of money, a hoarder, and in all senses a miser.

Those who cannot themselves study these truths, should aid others in the cause, should encourage scientific institutions, and encourage the grand work to the extent of their power. As it is at present, Government is alone in this work, while private funds might greatly aid in its prosecution. Under the efficient management of Professor Baird, the United States is doing a lion's share of marine research, and we hope that the present Commissioner may long retain his office, and continue his intereting work.

ELIAS HOWE completed the first sewing-machine in 1845.

RECENT PROGRESS IN SCIENCE.

THE English people are becoming aroused to the dangers of too much study on the part of children in the public schools, and a governmental commission has been examining the matter from a medical point of view, with a view to moderating the excessive requirements. Great public interest is manifested. Agitation in regard to over-pressure in schools has already been active in Germany, and in France the Minister of Public Instruction has lately reduced the daily hours of study. In Switzerland, where the evidences of over-pressure were startling when brought to light, the cantonal governments are considering how they shall be avoided in future. At the recent International Medical Congress in Copenhagen, statements derived from a study of European schoolchildren generally were made which produced a strong impression; but as yet the United States is only partially awake to the danger which threatens the health of children whose brains are overtaxed by the ambitious requirements of the public schools, and whose whole health suffers in consequence. The symptoms of excessive brain-work on the part of children, as they have been noticed carefully in Europe by experts, are headache, sleeplessness, intellectual torpor, muscular weakness and spasm, culminating in hallucination, and often in sudden loss of consciousness. It has been well said that we should be very cautious how we advocate in America the introduction of European methods of education, until we are fully informed as to their effects upon the pupils.

THE Amazon and adjacent rivers, like the Araguary, are notoriously muddy, especially near their mouths, a fact due largely to the devastation made upon the soft banks by the *pororoca*, or violent flood of the inflowing tide—the same rushing, overwhelming wave which in the Ganges is known as the "bore." The great quantities of soil brought down by these vast streams are drifted out to sea, the distance to which they are carried depending upon their lightness and fitness, the action of their specific gravity and the movement of the water sorting them with the greatest accuracy, and laying down in regular succession deposits each of which is homogeneous in its material. Thus soundings determine that across the mouth of the Amazon for 200 miles, and for 400 miles out to seaward, and swept northward by the prevalent ocean currents, beds of sandstone and shale are being rapidly laid down, some of which is brought all the way from the Andes, while in many places within the mouth dense tropical forests are being buried (after having been undermined, or uprooted, and prostrated by the *pororoca*, or the Spring floods) beneath the fine sediment thrown down by the muddy waters of the great river.

IT was announced some time ago by the London journals that an expedition had been organized by Mr. H. O. Forbes, F.R.G.S., already well known to geographers and zoologists from his explorations in Timor Laut, with the object of exploring the botany and zoology of the Mount Owen Stanley Mountains, the great central range of the eastern peninsula of New Guinea. The British Association voted £400, and the Royal Geographical Society £250, toward the expenses of the expedition. Mr. Forbes proposed to ascend the course of one of the rivers which flow from the mountains to Redscar Bay. Should the natives prove friendly, and the food supply sufficient, Mr. Forbes does not despair of reaching the other coast of the peninsula, but in any case the exploration of the Mount Owen Stanley range would be of itself a satisfactory achievement. The mountain traveling is declared to be dangerous to any but very experienced travelers. Though the expedition started in December, it is not expected to get actively at work before May of 1885, in consequence of the necessity of procuring trusty carriers from the Moluccas, and other preparations. Much is expected by geographers from the exploration of this little-known and alluring region.

A PHYSICIAN'S argument in favor of the playing (not to excess) of lawn-tennis and similar games, is wisely based on the æsthetic and moral good derived by a person from a sound and well co-ordinated muscular condition. The muscular mass of the human system, he reminds us, is a large one. It makes up forty per cent. of the total bodily weight, and leaving out the skeleton, which has a mechanical function only, we are two-thirds muscle. Besides, it is supplied throughout with the nerves which excite it, and with sensory nerves, which notify to the brain any use or misuse, illness or health. There may be a fair state of health, but there can be no exuberant vigor, none of the lusty *joie de vie*, without perfectly nourished and perfectly behaving muscles. Thus, when overused or poorly nourished, we have the sensations of fatigue, lassitude, and *malaire*, such as are complained of by thousands of underfed and overworked persons; furthermore, as the muscle retires, the nerve comes unduly to the front, and we have the consequent evils of nervousness, irritability, and their train. The good of a well-developed muscular condition is therefore far-reaching and spiritual, as well as practical.

THE *Athenæum* states that Dr. Wedding, of England, has been making experiments showing that the capacity for welding iron increases with the amount of silicon present, and decreases with any excess of manganese, because the latter seems to interfere (as do all adventitious bodies to a certain extent) with the proper crystallization of the iron.

CAPTAIN KOSTOVICH, of the Russian Navy, according to *Science*, proposes the use of a small captive balloon, to which an Edison electric light is suspended, for night signaling at sea. By the aid of connecting wires the lamp may be lighted and extinguished at will, and the apparatus may thus be intelligibly used with any code.

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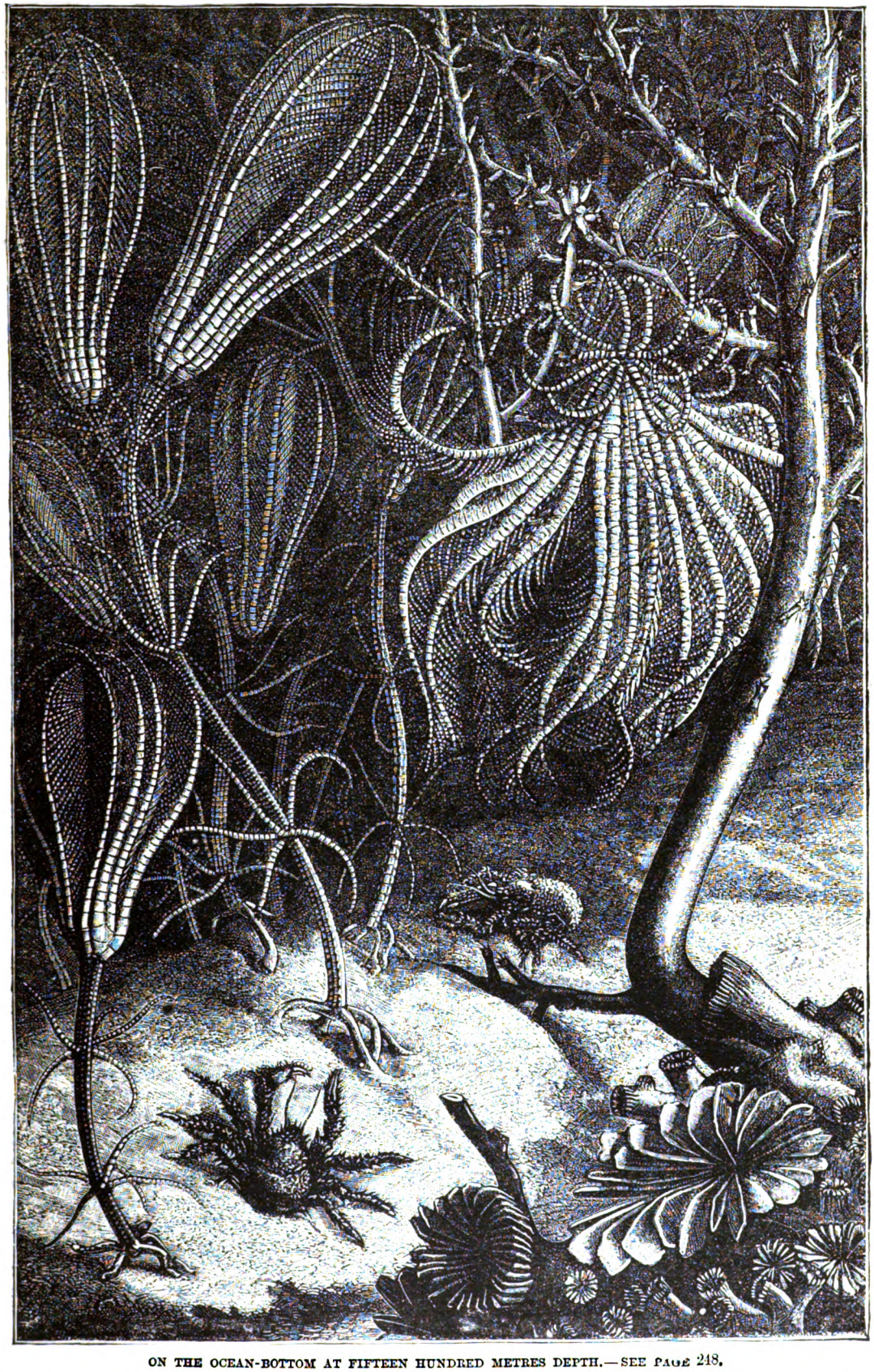

ON THE OCEAN-BOTTOM AT FIFTEEN HUNDRED METRES DEPTH.—SEE PAGE 248.

mother's lullaby above the cradle, and then again so cold, with such a piercing sting sheathed in his courteous speech?

She could have smote him where he stood. He was kind at heart; she knew that well, for she had watched him keenly. She had noticed in their walks, when a worm lay in his path, he had been quick to

—"Tread aside and let the reptile live,"

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